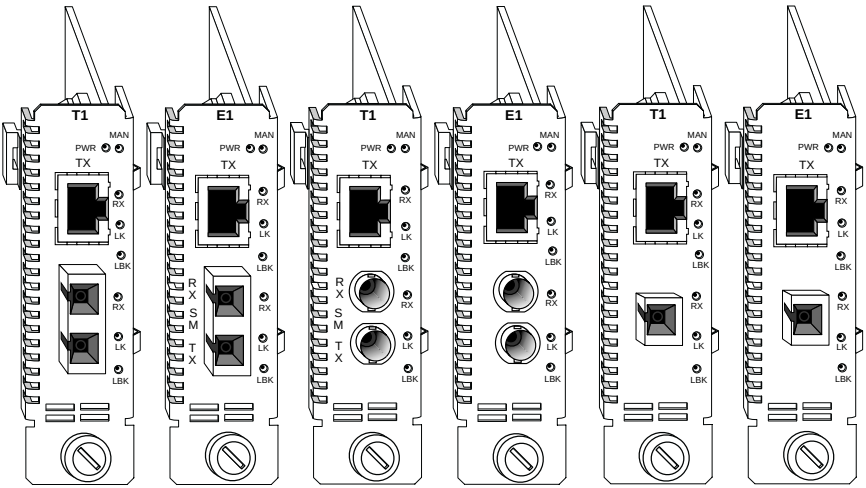
METRObility optical systems

RADIANCE
T1/E1
SINGLE INTERFACE LINE CARDS



Installation & User Guide

Models: R105-13 / R105-14 / R105-15 / R105-16 /
R105-17 / R105-1J / R105-1X / R105-1Y /
R165-13 / R165-14 / R165-15 / R165-16 /
R165-17 / R165-1J / R165-1X / R165-1Y

Radiance T1/E1 Single Interface Line Cards

T1 Copper to T1 Fiber:

R105-13	_____	T1 RJ-45 to T1 multimode SC
R105-14	_____	T1 RJ-45 to T1 singlemode SC
R105-15	_____	T1 RJ-45 to T1 multimode ST
R105-16	_____	T1 RJ-45 to T1 singlemode ST
R105-17	_____	T1 RJ-45 to T1 singlemode SC (40km)
R105-1J	_____	T1 RJ-45 to T1 singlemode SC (100km)
R105-1X	_____	T1 RJ-45 to T1 singlemode SC 1550/1310nm bidirectional wavelength division multiplexed (BWDM)
R105-1Y	_____	T1 RJ-45 to T1 singlemode SC 1310/1550nm BWDM

E1 Copper to E1 Fiber:

R165-13	_____	E1 RJ-45 to E1 multimode SC
R165-14	_____	E1 RJ-45 to E1 singlemode SC
R165-15	_____	E1 RJ-45 to E1 multimode ST
R165-16	_____	E1 RJ-45 to E1 singlemode ST
R165-17	_____	E1 RJ-45 to E1 singlemode SC (40km)
R165-1J	_____	E1 RJ-45 to E1 singlemode SC (100km)
R165-1X	_____	E1 RJ-45 to E1 singlemode SC 1550/1310nm BWDM
R165-1Y	_____	E1 RJ-45 to E1 singlemode SC 1310/1550nm BWDM

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Overview

The Radiance T1/E1 line card from Metrobility Optical Systems provides high-speed integration and conversion of T1 (1.544Mbps) or E1 (2.048Mbps) serial copper telco communication lines to fiber transport environments. Regardless of the line codes or framing, the copper data stream is converted to optical signals for greater noise immunity and longer transmission. The T1/E1 line card supports remote fiber optic links up to 2km over multimode and up to 100km over singlemode cable. Also available are the dual wavelength multiplexed units which allow you to double your fiber capacity and support singlemode segments up to 20km.

To optimize your T1/E1 network, this hot-swappable media converter operates seamlessly with a low bit delay. All signal activity is completely converted ensuring accurate communication within connected segments. The Radiance T1/E1 line card is totally frame and data independent and features user-selectable line build out.

For testing a full-duplex fiber optic link, the T1/E1 line card is designed with a built-in Bit Error Rate Test (BERT). Management of the line card allows a managed device to obtain information without consuming valuable user bandwidth. Management options supported by the Radiance T1/E1 line cards include terminal console commands, Metrobility's GUI-based NetBeacon® or WebBeacon software, or any SNMP application. This ability provides remote control over the line card's configuration and immediate notification of a problem to a management station.

The Radiance T1/E1 line card offers the following key features:

- AMI or B8ZS (T1) / HDB3 (E1) bipolar line code support on the copper interface.
- Eight LED indicators for easy visual diagnostics.
- Local and remote loopback monitoring plus BERT 511 testing.
- Variable line length selection to set the proper T1/E1 pulse shape.
- MDI-II to MDI-X switch on the copper port to eliminate the need for crossover cables.
- Copper to multimode conversion up to 2km, copper to BWDM conversion up to 20km, or copper to singlemode conversion up to 100km.
- Far End Fault notification.
- Low jitter for maximum transmission quality.
- Low power consumption (≤ 3W).
- Hot swappable.

Installation Guide

Follow the simple steps outlined in this section to install and start using your Radiance T1/E1 single interface line card.

NOTE: *Electrostatic discharge precautions should be taken when handling any line card. Proper grounding is recommended (i.e., wear a wrist strap).*

1 Unpack the Line Card

Check that the following components have been included in your order:

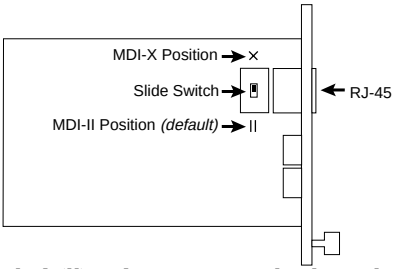
- Radiance T1/E1 single interface line card
- 2 SC-to-ST adapters (R105-16 and R165-16 only)

Your order has been provided with the safest possible packaging, but shipping damage does occasionally occur. Inspect your order carefully. If you discover any shipping damage, notify your carrier and follow their instructions for damage and claims. Save the original shipping carton if return or storage of the unit is necessary.

2 Set the Switches

MDI-II/MDI-X Switch

To eliminate the need for crossover cables, the T1/E1 line card features an MDI-II/MDI-X switch for its copper port. The switch is located directly behind its associated RJ-45 connector. Use the slide switch to configure the port for either a straight-through or crossover connection.



- The parallel symbol (**II**) indicates a straight-through or parallel connection. *(default)*
- The cross symbol (**X**) indicates a crossover connection.

A device that is wired straight through needs one crossover connection:	
If the cable is	the MDI-II to MDI-X switch setting should be
straight through	**X**
crossover	**II**

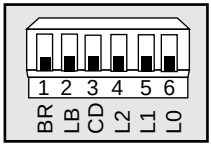
A device that is wired crossover needs a parallel connection:	
If the cable is	the MDI-II to MDI-X switch setting should be
straight through	**II**
crossover	**X**

DIP Switches

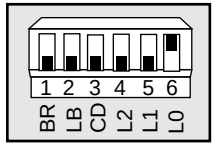
A bank of six DIP switches is located on the back of the card. The switches allow you to select from several modes of operation and to set the transmitter's output pulse shape. Refer to the table below for the proper setting of the DIP switches.*

When setting DIP switches, the UP position is when the lever of the DIP switch is pushed away from the circuit board. The DOWN position is when the lever is pushed toward the board. Shown below are the default switch settings for the T1 and E1 boards.

Default T1 Settings



Default E1 Settings



Switch Number	Switch Label	Position	Function
1	BR	UP	Bit Error Rate Test (BERT) is enabled.
		DOWN	BERT is disabled; normal operation.
2	LB	UP	Loopback is enabled on the copper and fiber ports.
		DOWN	Loopback is disabled; normal operation.
3	CD	UP	Alternate Mark Inversion (AMI) line coding is used for receiving and transmitting data.
		DOWN	B8ZS (T1) or HDB3 (E1) line coding is used for receiving and transmitting data.
4	L2	UP	Line length bit 2 is **1**.
		DOWN	Line length bit 2 is **0**.
5	L1	UP	Line length bit 1 is **1**.
		DOWN	Line length bit 1 is **0**.
6	L0	UP	Line length bit 0 is **1**.
		DOWN	Line length bit 0 is **0**.

*DIP switches also can be managed by console commands or with Metrobility NetBeacon or WebBeacon management software. Refer to the *Command Line Interface Reference Guide, NetBeacon Element Management Software Installation & User's Guide* or *WebBeacon Management Software Installation & User's Guide* for software management information.

BR Switch
Use the Bit Error Rate Test switch to test the fiber optic connection between two T1/E1 line cards. If BERT 511 is enabled on the locally managed card, it will generate a 511 pattern on the data channel and request temporary loopback via the management channel. The remote card will then put itself into loopback on the fiber port and send the BERT data back to the local card. The default state of the BERT switch is disabled (down).

LB Switch
The LB switch enables local loopback which isolates the copper side from the fiber side. This allows the incoming data on each side to loop back on their own media line and return to their sending devices. The default state of the local loopback switch is disabled (down). For more information, refer to Diagnostic Modes in the User Guide section.

CD Switch
The line code switch determines whether AMI or B8ZS / HDB3 coding is used for receiving and transmitting data. The default setting is B8ZS for a T1 card and HDB3 for an E1 card. These are the settings used in most applications. AMI (bipolar) coding is common in legacy applications.

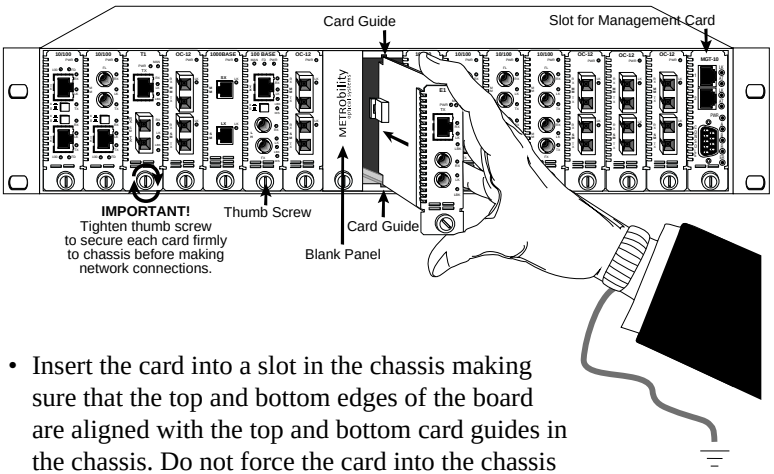
L2, L1 and L0 Switches
These switches determine the shape of the transmitter's output pulse. The default is 0, 0, 0 for T1 and 0, 0, 1 for E1.
(0 = down; 1 = up)

L2	L1	L0	T1 Line Build Out	E1 Line Build Out
0	0	0	DSX-1 (0-133 ft) / 0 dB CSU	
0	0	1	DSX-1 (133-266 ft)	120 ohms normal
0	1	0	DSX-1 (266-399 ft)	
0	1	1	DSX-1 (399-533 ft)	
1	0	0	DSX-1 (533-655 ft)	
1	0	1	-7.5 dB CSU	
1	1	0	-15 dB CSU	
1	1	1	-22.5 dB CSU	

3 Install the Line Card

The Radiance T1/E1 line card offers the ease of plug-and-play installation and is hot-swappable. The card must be firmly secured to the chassis before network connections are made. Follow the simple steps outlined below to install your line card.

- Grasp the card by the front panel as shown.



- Insert the card into a slot in the chassis making sure that the top and bottom edges of the board are aligned with the top and bottom card guides in the chassis. Do not force the card into the chassis unnecessarily. It should slide in easily and evenly.

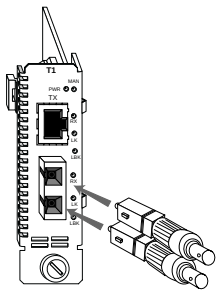
- Slide the card in until the top and bottom edges of the front panel are flush and even with the top and bottom edges of the chassis.

- To secure the line card to the chassis, turn the thumbscrew clockwise until it is snug. The card is now properly installed and, excluding the R105-16 and R165-16, ready for network connections.

4 Attach the Adapters

(R105-16, R165-16 Only)

The fiber ports on these models are equipped with SC connectors and require two SC-to-ST adapters, which are included with your order.

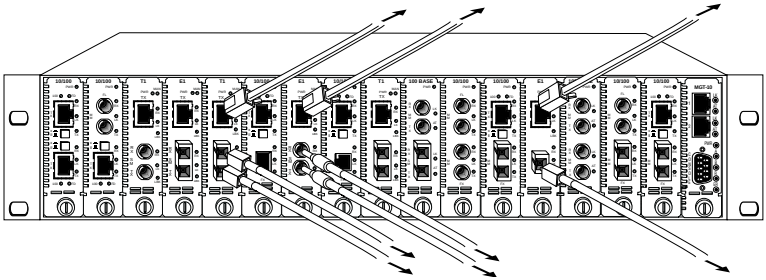


To connect the adapters to the line card, first remove the protective coverings from both ends of

the adapters. Next, insert the SC ends of the adapters into the SC connectors on the Radiance T1/E1 line card. The card is now ready to be connected to the network.

5 Connect to the Network

To connect the line card to the network, insert the cables into the appropriate connectors as illustrated. Make sure the card is secured to the chassis before making network connections. Once power is applied to the unit, correct connectivity can be verified via the link (LK) LED.



Twisted-Pair Interface

The twisted-pair port provides a shielded RJ-45 connector. It supports a maximum segment length of 1,310 feet for short haul or 4,500 feet (22 dBm) for long haul Channel Service Unit (CSU) operation.

Fiber Optic Interface

The line card's fiber optic receive (RX) port is located above its transmit (TX) port. When making network connections, make sure that the receive port of the card connects to the transmit port of the connected device, and make sure that the receive port of the connected device connects to the transmit port of the line card.

The fiber optic multimode interface supports a maximum segment length of 2km for remote links.

The standard singlemode (SM) connector supports a maximum segment length of 15km. The singlemode long haul interface (R105-17 and R165-17) supports a maximum segment of 40km. The singlemode extended long haul interface (R105-1J and R165-1J) supports a maximum segment length of 100km.

BWDM Interface

The bidirectional wavelength division multiplexed (BWDM) port provides one singlemode SC connector that supports a maximum segment length of 20km. BWDM line cards must be used in pairs. That is, a -1X model always must be connected to a -1Y. The -1X cards are designed to transmit data at a wavelength of 1550nm and receive at 1310nm. Correspondingly, the -1Y cards transmit at 1310nm and receive at 1550nm.

User Guide

This section contains more detailed information regarding the operating features of the Radiance T1/E1 single interface line card.

LED Indicators

The Radiance T1/E1 single interface line card provides several system and port LEDs for the visible verification of unit status and proper functionality. These LEDs can aid in troubleshooting and overall network diagnosis and management.

System LEDs

LED Label	Color (Status)	Indication
PWR	Green (steady)	Unit is receiving power.
	(off)	Unit is not receiving power or has failed.
MAN	Green (steady)	Unit is receiving good management frames. Management frames are sent only when Far End Fault is detected or when the card is in temporary loopback mode because remote fiber loopback is enabled.
	(off)	No management frames are being received. Normal operation.

Copper Port LEDs

LED Label	Color (Status)	Indication
RX	Green (steady)	Receiving carrier on inbound copper line. RX is normally ON and indicates that the incoming data and clock are within tolerance.
	(off)	The carrier is lost. (Red Alarm)
LK	Green (steady)	Normal operation. Copper link is up (no alarm condition).
	Green (blinking)	There is a bipolar violation (T1) or a code violation (E1). A bipolar violation (BPV) is two consecutive marks with the same polarity, unless it is part of a B8ZS sequence. A code violation is two consecutive BPVs with the same polarity.
	(off)	Alarm condition on the incoming stream. • If RX LED is OFF, the carrier is lost. (Red Alarm) • If RX LED is ON, port is receiving AIS (unframed all 1s) from the sending device. (Blue Alarm)
LBK	Yellow (steady)	Copper port is in loopback mode. Inbound data on the copper pair is regenerated and sent back on the transmit copper pair.
	(off)	Normal operation. Loopback is disabled on the copper port.

Fiber Optic Port LEDs

LED Label	Color (Status)	Indication
RX	Green (steady)	Receiving pulses on inbound fiber line. RX is normally ON and indicates that the inbound fiber line has a signal.
	Green (blinking)	Receiving BERT 511 sequence.
	(off)	The carrier is lost. (Red Alarm)
LK	Green (steady)	Normal operation. Fiber link is up (no alarm condition).
	Yellow (blinking)	Receiving BERT 511 sequence which contains occasional bit errors.
	Yellow (steady)	The remote T1/E1 unit is not detecting link on its inbound fiber port and is reporting Far End Fault via the management channel. (Yellow Alarm)
	(off)	Alarm condition on the incoming stream. • If RX LED is OFF, the carrier is lost. (Red Alarm) • If RX LED is ON, port is receiving AIS (unframed all 1s) or bad pulses from the sending device. (Blue Alarm)
LBK	Yellow (steady)	Fiber port is in loopback mode. Incoming data on the fiber port is sent back on the transmit fiber line.
	(off)	Normal operation. Loopback is disabled on the fiber port.

Software Port Indicators

In addition to the LEDs, you can view the status of several alarms and indicators for each port on the Radiance T1/E1 line card via software*. The software indicates whether or not the conditions listed below are occurring.

Copper Port

Status Indicators
- Detecting link
- Receiving carrier line signal
- Port state

Alarm Indicators
- Receiving AIS
- Receiving code violations

Fiber Port

Status Indicators
- Detecting link
- Receiving carrier line signal
- Receiving Request for Temporary Loopback
- Receiving management packet
- Receiving BERT 511 pattern
- Port state

Alarm Indicators
- Receiving BERT errors
- Receiving AIS
- Receiving Far End Fault

* Refer to the *Command Line Interface Reference Guide*, *NetBeacon Element Management Software Installation & User's Guide* or *WebBeacon Management Software Installation & User's Guide* for software management information.

Theory of Operation

Coding Scheme and Clocking

T1/E1 data is carried over copper lines using either AMI or B8ZS (T1)/HDB3 (E1) coding, which encodes both the data and clock. AMI, B8ZS, and HDB3 require a transport medium that can carry both positive and negative pulses, as well as a zero level. This is not possible with fiber, in which transmitters are either off or on. To properly transport the information over fiber lines and simplify clock extraction, the T1/E1 line card uses a Pulse Width Modulation (PWM) scheme that converts the T1/E1 data to a format suitable for fiber optic communication. The fiber receiver on the remote T1/E1 line card then restores the signal back to its original format.

The PWM data provides a composite pulse for each incoming data bit, ensuring that the original timing information for each bit is transferred and recoverable. No synchronizing headers are necessary, resulting in faster recovery from lost signal errors and ensuring timing transparency and the accurate transfer of data.

Data Transparency

The Radiance T1/E1 single interface line card offers full data transparency. Any codes or commands contained within the data stream are passed through to the remote device. The only commands executed by the T1/E1 card are those set through the hardware (i.e., DIP switches) or software, which communicates with the card via the management bus on the chassis backplane.

Factory Settings

Default Hardware Settings

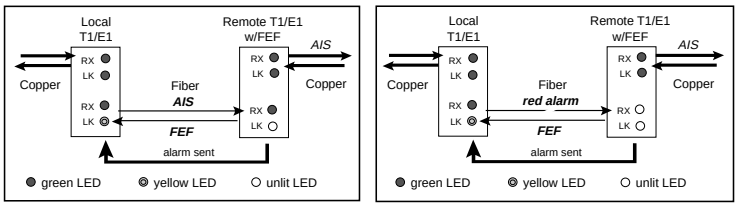
MDI-II/MDI-X ..... Parallel (II)
RJ-48 Pin Out ..... 1, 2 (TX Output)
..... 4, 5 (RX Input)
BERT 511 ..... Disabled
Local Loopback ..... Disabled
Line Code B8ZS (T1)
..... HDB3 (E1)
Line Length Bits (L2, L1, L0) 0, 0, 0 (T1)
..... 0, 0, 1 (E1)
Line Build Out ..... DSX-1 (0-133 ft) / 0 dB CSU (T1)
..... 120 Ω normal (E1)

Default Software Settings

The following settings can only be changed via software commands.*
Far End Fault ..... Enabled
Port Enable/Disable ..... Enabled
Remote Loopback ..... Disabled

Far End Fault

Far End Fault (FEF) is only applicable to the fiber optic port. FEF enables the locally managed T1/E1 line card to detect loss of link (red or blue alarm) on the remote card's fiber port receiver. If FEF is enabled on a remote card and its fiber port receiver loses its carrier or receives AIS, the card will send an unsolicited alarm to the local T1/E1 card via the management channel on the fiber line, thus turning the local card's MAN LED green. The local card also reports the condition with a yellow LK LED on its fiber port, as illustrated below.



Because the fiber LK LED is used to display both FEF and blue alarm conditions, if both conditions occur at the same time, the blue alarm will take priorty over FEF. Although both alarms will be transmitted, only the blue alarm will be displayed through the LEDs (i.e., fiber LK off and fiber RX on). Both alarm indicators can be viewed through software.

* Refer to the *Command Line Interface Reference Guide*, *NetBeacon Element Management Software Installation & User's Guide* or *WebBeacon Management Software Installation & User's Guide* for software management information.

Port Enable/Disable

Either port on the T1/E1 line card can be enabled or disabled independently. Disabling a port has no effect on the incoming data, however, the outgoing data from that port is dropped and AIS is transmitted (see Figures 1 and 2). If the fiber port is disabled and FEF is enabled on the remote card, the remote card will send an alarm and the disabled port's LK LED will be yellow (see Figure 2). If FEF is disabled, that LED will be green. Once a port is disabled, it can only be enabled again through software.

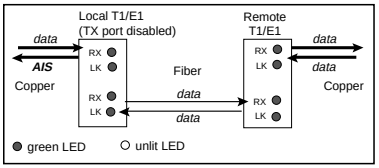


Figure 1

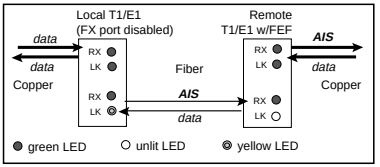


Figure 2

Remote Loopback

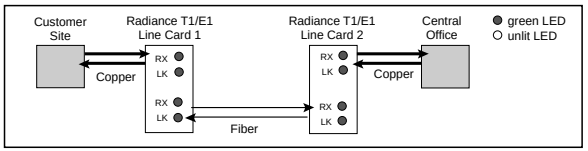
Refer to Remote Loopback on page 18 for details.

Link Loss Indications

The following illustrations show the status of the RX and LK LEDs under various link conditions. Note that the T1/E1 line card only generates blue alarms (AIS) on the data channel. It never generates yellow alarms, although it does propagate them. The T1/E1 line card relies on the equipment at the customer site or central office to convert blue alarms to yellow. (Loopback is disabled in these examples.)

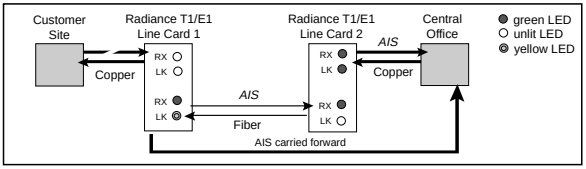
Normal

The diagram below shows a typical configuration with good link status.



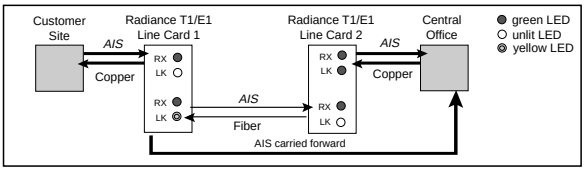
Input Copper Link Loss

Loss of the copper input forces the T1/E1 card to generate AIS, which is transmitted out the fiber port. For example, if Card 1's inbound copper line breaks, it will transmit AIS to Card 2 via the fiber cable. Card 2 will then carry the AIS forward via its copper cable to the Central Office and send a FEF alarm to Card 1. (If Far End Fault is disabled on Card 2, no FEF alarm will be sent and the fiber LK LED on Card 1 will be green.)



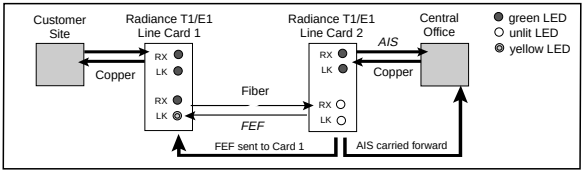
Input Copper AIS

If Card 1's copper interface receives AIS, the card will transmit the alarm to Card 2, which then transmits it to the Central Office and sends a FEF alarm back to Card 1. Notice that in this example, the copper RX LED on Card 1 remains green since the line is intact. (If Far End Fault is disabled on Card 2, no FEF alarm will be sent and the fiber LK LED on Card 1 will be green.)



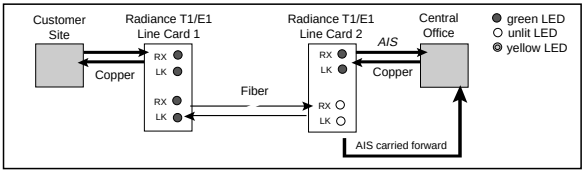
Input Fiber Link Loss with FEF

If a card's inbound fiber line breaks, the card will generate AIS which is transmitted over its copper cable. In the example below, Card 2 has lost its fiber input and is sending AIS to the Central Office. Additionally, when Far End Fault is enabled, Card 2 transmits an alarm via the fiber management channel and Card 1 reports the condition with a yellow fiber LK LED and green MAN LED. FEF is only carried on the fiber link between adjacent Radiance line cards.



Input Fiber Link Loss without FEF

If Card 2 loses its input fiber link and FEF is disabled*, Card 2 will only send AIS to the Central Office. It will NOT send a FEF alarm and Card 1's fiber LK LED will remain green.



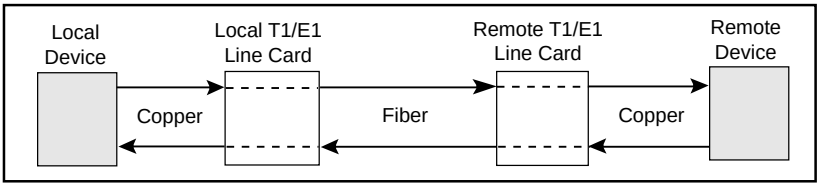
* FEF is disabled through software only.

Diagnostic Modes

The Radiance T1/E1 line card features BERT 511 and loopback testing to help verify correct installation and diagnose system problems.

Normal

During normal operation, data from a local device (CSU, PBX, etc.) enters the local T1/E1 line card's copper receiver, passes through the fiber line between the two cards, then exits out the remote card's copper transmitter to enter the remote equipment, and vice versa.



Far End Fault

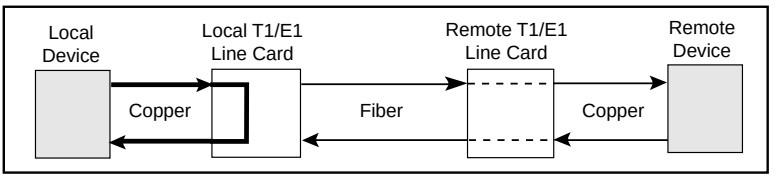
Typically, Far End Fault (FEF) is enabled on the remote card to notify the local card of a fiber line failure. Refer to Far End Fault on page 13 and Input Fiber Link Loss with FEF on page 15 for more information.

Loopback

Loopback helps a network manager to isolate traffic problems within a particular segment (local copper, fiber, or remote copper cable). During loopback, the LBK LED will be yellow and the RX LED green. Loopback is enabled/disabled in two ways: (1) through hardware by setting a DIP switch, or (2) through software by enabling loopback on Port 1 and/or Port 2. Once loopback is enabled, the card remains in this mode until you reset the DIP switch or change the software setting.

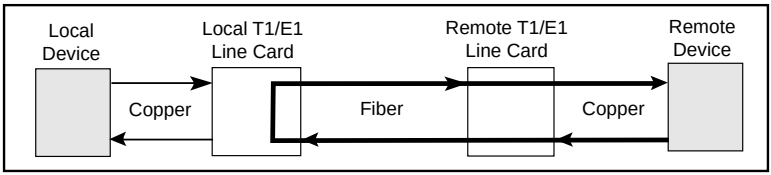
Local Port Loopback

Through software, you can apply loopback individually to either port on the local T1/E1 line card. To configure copper loopback*, enable/disable loopback on Port 1 of the local card. Only the data on the copper line is looped back to the sending device when copper loopback is enabled.



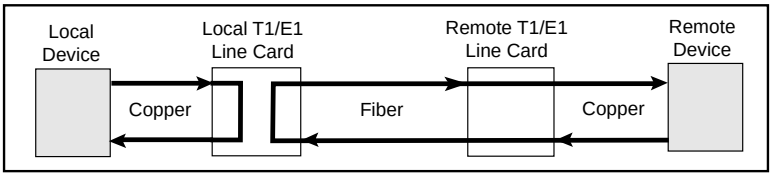
* Copper loopback has priority over AIS due to fiber failure. Copper port disable has priority over loopback.

To configure fiber loopback*, enable/disable loopback on Port 2 of the local card. Only the data on the fiber line is looped back to the sending device when fiber loopback is enabled.



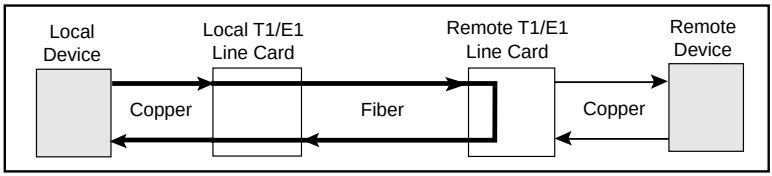
Dual-Port Loopback

In this mode, data on both ports of the local card are looped back to their sending devices. Dual-port loopback is configurable through hardware by setting DIP Switch 2 (LB), or via software by enabling loopback on Port 1 and Port 2.



Remote Loopback

In this mode, data on the fiber line is looped at the remote end back to the sending device. (The remote T1/E1 unit can be either another line card or a standalone unit.) Remote loopback* is configurable only through software by enabling it from fiber port on the locally managed T1/E1 line card.

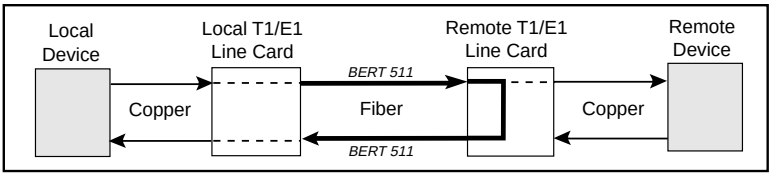


Bit Error Rate Test (BERT)

To test the fiber connection between two T1/E1 line cards, you can enable the built-in BERT 511, which generates a test sequence to verify proper looping. BERT is not applicable to the copper port. It is configurable through hardware by setting a DIP switch or via software commands. Setting DIP Switch 1 (BR) automatically enables two functions: BERT 511 and remote loopback. Through software, both of these port functions must be set individually.

* Fiber loopback and remote loopback have priority over AIS due to fiber failure and BERT 511. Fiber port disable has priority over loopback.

If both functions are enabled on the locally managed card, the fiber port will generate a 511 pattern on the data channel and request temporary loopback on the management channel. The remote card then puts itself into loopback on the fiber port and sends the BERT data back to the local card. When the local card receives the test data, its fiber RX LED blinks green. If there were any errors, the local card's fiber LK LED blinks yellow.



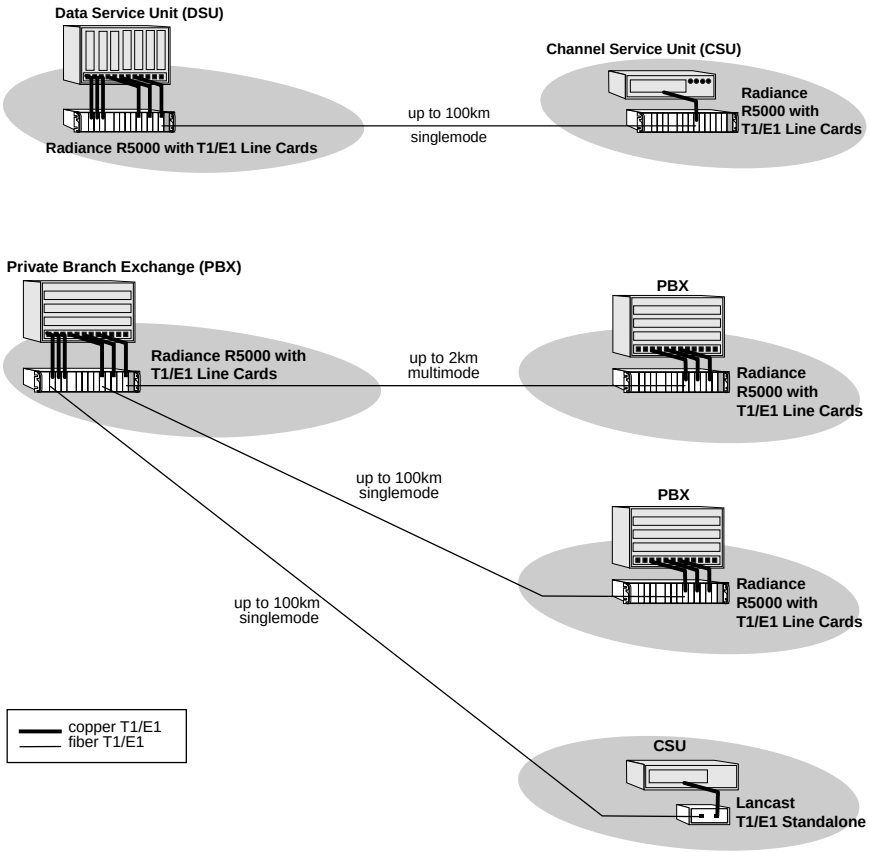
Because BERT 511 is set independently through software, you can use it to test segments beyond the fiber link. For example, you can enable BERT 511 on the local T1/E1 card, without setting remote loopback, to verify that the remote device is receiving and sending the test data properly.

BERT 511 is a random sequence generated by the polynomial $x^9 + x^5 + 1$, which repeats every 511 bits. It is implemented by a linear feedback shift register. BERT 511 is detected when there is 1 or fewer bad BERT 511 bits in 512 data bits.

Fiber loopback has priority over BERT 511.

Topology Solutions

The Radiance T1/E1 single interface line card is a point-to-point media converter designed to extend the reach of copper T1/E1 links and to provide protection from power surges and electromagnetic interference. Each T1/E1 line card supports a single remote T1/E1 unit.



Technical Specifications

Network Connections

Twisted-Pair Interface

Connector _____ Shielded RJ-45, 8-pin jack
Impedance _____ 100 Ohms T1 (balanced pair)
_____ 120 Ohms E1 (balanced pair)
Supported Link Length _____ up to 1,310 feet (short haul)
_____ up to 22.5 dBm or 4,500 feet (long haul CSU)
Cable Type _____ Category 5 UTP

Multimode Fiber Optic Interface
(R105-13, R105-15, R165-13, R165-15)

Connector _____ ST or SC
Wavelength _____ 1310 nm
RX Input Sensitivity _____ -31 dBm peak minimum
Output Power _____ -20 dBm to -14 dBm (62.5/125 µm)
Supported Link Length _____ up to 2km full duplex
Cable Type _____ 50/125, 62.5/125 µm F/O

Singlemode Fiber Optic Interface
(R105-14, R105-16, R165-14, R165-16)

Connector _____ ST or SC
Wavelength _____ 1310 nm
RX Input Sensitivity _____ -31 dBm peak minimum
Output Power _____ -15 dBm to -8 dBm (9/125 µm)
Supported Link Length _____ up to 15km full duplex
Cable Type _____ 8.3/125, 8.7/125, 9/125, 10/125 µm F/O

Singlemode Fiber Optic Interface — long haul distance support
(R105-17, R165-17)

Connector _____ SC
Wavelength _____ 1310 nm
RX Input Sensitivity _____ -35 dBm minimum
Output Power _____ -5 dBm to 0 dBm (9/125 µm)
Supported Link Length _____ up to 40km full duplex
Cable Type _____ 8.3/125, 8.7/125, 9/125, 10/125 µm F/O

Singlemode Fiber Optic Interface — extended long haul distance support
(R105-1J, R165-1J)

Connector	SC
Wavelength	1550 nm
RX Input Sensitivity	-37 dBm minimum
Output Power	-3.0 dBm to 0 dBm (9/125 µm)
Supported Link Length	up to 100km full duplex
Cable Type	8.3/125, 8.7/125, 9/125, 10/125 µm F/O

Singlemode BWDM Fiber Optic Interface

Connector	SC
Supported Link Length	up to 20km full duplex
RX Input Sensitivity	-31 dBm minimum
Output Power	-15.0 dBm to -8.0 dBm
Cable Type	9/125 µm F/O

(R105-1X, R165-1X)

TX Wavelength	1550 nm
RX Wavelength	1310 nm

(R105-1Y, R165-1Y)

TX Wavelength	1310 nm
RX Wavelength	1550 nm

Data Rate

Data Rate	1.544Mbps (T1); 2.048Mbps (E1)

Power

Input	+5.0VDC @ 0.6A, 3W average

Environmental

Operating Temperature	0° to 50° C
Storage Temperature	-30° to 70° C
Relative Humidity	5% to 95% non-condensing
Weight	5 oz (0.14 kg)

Acronyms and Abbreviations

This list defines the acronyms and abbreviations used in this guide.

AIS	Alarm Indication Signal
AMI	Alternate Mark Inversion (bipolar) line coding for T1 and E1
B8ZS	Bipolar Eight Zeroes Substitution T1 line coding
BERT, **BR**	Bit Error Rate Test
BPV	Bipolar Violation
BWDM	Bidirectional Wavelength Division Multiplexed interface
CD	Line code
CSU	Channel Service Unit
DSU	Data Service Unit
DSX-1	Digital Signal Cross-Connect; the T1 electrical interface specification
E1	2.048 Mbps communications standard
FEF	Far End Fault, an alarm indicating that the remote unit's fiber receiver is lost
F/O	Fiber Optic
FPGA	Field-Programmable Gate Array
HDB3	High Density Bipolar Three Zeroes Substitution E1 line coding
L2, L1, L0	Line length bits 2, 1, and 0, respectively
LB, **LBK**	Loopback
LK	Link
MAN	Management frames
Mbps	Megabits per second
MDI-II	Media Dependent Interface—Parallel
MDI-X	Media Dependent Interface—Crossover
MM	Multimode
NRZ	Non-Return to Zero line coding
PBX	Private Branch Exchange
PWM	Pulse Width Modulation
PWR	Power
RX	Receive
SM	Singlemode
T1	1.544 Mbps communications standard
TX	Transmit
UTP	Unshielded Twisted Pair

Product Safety, EMC and Compliance Statements

This equipment complies with the following requirements:

- UL
- CSA
- EN60950 (safety)
- FCC Part 15, Class A
- EN55022 Class A (emissions)
- EN55024: 1998 (immunity)
- IEC 825-1 Classification
- DOC Class A (emissions)
- ITU-G.703
- G.704
- G.706
- G.824
- ANSI T1.403-1999
- ANSI T1.408
- Class 1 Laser Product

This product shall be handled, stored and disposed of in accordance with all governing and applicable safety and environmental regulatory agency requirements.

The following *FCC* and *Industry Canada* compliance information is applicable to North American customers only.

USA FCC Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Caution: *Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.*

Canadian Radio Frequency Interference Statement

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Réglement sur le matériel brouilleur du Canada.

Warranty and Servicing

Three-Year Warranty for Radiance T1/E1 Single Interface Line Card

Metrobility Optical Systems, Inc. warrants that every Radiance T1/E1 single interface line card will be free from defects in material and workmanship for a period of THREE YEARS from the date of Metrobility shipment. This warranty covers the original user only and is not transferable. Should the unit fail at any time during this warranty period, Metrobility will, at its sole discretion, replace, repair, or refund the purchase price of the product. This warranty is limited to defects in workmanship and materials and does not cover damage from accident, acts of God, neglect, contamination, misuse or abnormal conditions of operation or handling, including overvoltage failures caused by use outside of the product's specified rating, or normal wear and tear of mechanical components.

To establish original ownership and provide date of purchase, complete and return the registration card or register the product online at www.metrobility.com. If product was not purchased directly from Metrobility, please provide source, invoice number and date of purchase.

To return a defective product for warranty coverage, contact Metrobility Customer Service for a return materials authorization (RMA) number. Send the defective product postage and insurance prepaid to the address provided to you by the Metrobility Technical Support Representative. Failure to properly protect the product during shipping may void this warranty. The Metrobility RMA number must be clearly on the outside of the carton to ensure its acceptance.

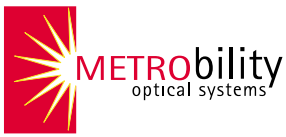
Metrobility will pay return transportation for product repaired or replaced in-warranty. Before making any repair not covered by the warranty, Metrobility will estimate cost and obtain authorization, then invoice for repair and return transportation. Metrobility reserves the right to charge for all testing and shipping costs incurred, if test results determine that the unit is without defect.

This warranty constitutes the buyer's sole remedy. No other warranties, such as fitness for a particular purpose, are expressed or implied. Under no circumstances will Metrobility be liable for any damages incurred by the use of this product including, but not limited to, lost profits, lost savings, and incidental or consequential damages arising from the use of, or inability to use, this product. Authorized resellers are not authorized to extend any other warranty on Metrobility's behalf.

Product Manuals
The most recent version of this manual is available online at
http://www.metrobility.com/support/manuals.htm

To obtain additional copies of this manual, contact your reseller, or call
1.877.526.2278 or 1.603.880.1833

Product Registration
To register your product, go to
http://www.metrobility.com/support/registration.asp



25 Manchester Street, Merrimack, NH 03054 USA
tel: 1.603.880.1833 • fax: 1.603.594.2887
www.metrobility.com

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